DOCUMENT RESUME

ED 304 440 SP 030 980

AUTHOR Rockler, Michael J.
TITLE Teaching Thinking Skills for the Twenty-First Century.
PUB DATE 88
NOTE 21p.; Paper presented at the Annual Meeting of the Association of Teacher Educators (St. Louis, MO, February 18-22, 1989).
PUB TYPE Viewpoints (120) -- Reports - Descriptive (141)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Cognitive Ability; *Cognitive Development; *Concept Formation; *Creative Thinking; *Critical Thinking; Elementary Secondary Education; Higher Education; Instructional Improvement; Metacognition; *Schemata (Cognition); Teaching Methods
IDENTIFIERS Brain Research; Dewey (John); *Thinking Skills

ABSTRACT

This paper examines the teaching of thinking skills for the future. An analysis of John Dewey's "How We Think" offers insights into cognition. Four types of thinking--reflective, conceptual, critical and creative--are explored. Aspects of brain research relevant to cognition are discussed. Specific ways to facilitate thinking and several strategies for improving thinking skills in the classroom are offered. It is pointed out that students must be stimulated by perplexing problems which have genuine meaning for them. Actual and vicarious experience enables students to improve their cognitive skills. Helping students to understand the nature of the contemporary social environment can also facilitate thinking. (Author/JD)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

TEACHING THINKING SKILLS FOR THE TWENTY—FIRST CENTURY

ED304440

Michael J. Rockler

Rutgers University

Camden, NJ 08102

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

M J. Rockler

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

INTRODUCTION

In a 1909 publication, John Dewey complained that classroom teachers emphasized information rather than thinking skills. Writing almost eighty years later, Vincent Ryan Ruggiero (7) distinguishes between "mindstuffing" and "mindbuilding." These writings indicate that the century now concluding has seen a lack of progress in the teaching of thinking skills. As the twenty-first century approaches, the need for improvement is becoming more imperative than ever.

The complexity of life in the twenty-first century may make effective thinking skills requisite to survival. In order to function in the high-tech world of the futuure, persons will need sophisticated cognitive abilities; this is true because of the vast number of choices that must be thoughtfully made. The ability to think effectively is not a luxury reserved for the highly educated. It is a skill needed by all persons who must face the complexity of an ever growing number of options.

The twenty-first century will see the continued growth of the mass

SP030 980

media. Televison, for example, can weaken thinking skills by encouraging people to to accept uncritically what they see. Often the media seeks to manipulate persons so that they will purchase products for non-rational reasons.

An even greater danger is the use of irrational appeals in political campaigns. The 1988 presidential campaign used "sound-bites"--brief messages designed for viewing on the evening news--to reflect favorably on the candidate. President Bush's effective use of these contributed to his victory. Better thinking skills are needed to enable persons to intelligently judge the message of political candidates. If this does not occur, America's democratic institutions may be in trouble.

This paper examines the teaching of thinking skills for the twenty-first century. An analysis of Dewey's How We Think (1) offers insight into cognition. Four types of thinking--reflective, conceptual critical and creative--are explored. Aspects of brain research relevant to cognition are discussed. Specific ways to facilitate thinking and several strategies for improving thinking in the classroom are offered.

JOHN DEWEY: HOW WE THINK

The importance of How We Think cannot be overstated. Most contemporary studies of metacognition were anticipated by John Dewey in 1909 in this volume (which he revised and reissued in 1933). Many of the reforms for the improvement of instruction adopted by the curriculum projects in the 1960's used ideas first suggested by Dewey in this work. Contemporary calls for the

reform of instruction continue to build on the framework of How We Think.

Dewey distinguishes between random thought and reflective thinking. The former occurs continually in the minds of all persons at all times; it can be equated with consciousness. Reflective thinking, however, requires something more. It begins for a specific purpose and moves toward an end. It is a process that can be facilitated; instruction in reflective thought ought to be a major component of teaching at all levels of education.

Dewey identifies several attitudes which he feels are concomitant with effective thinking. First is the quality of open-mindedness. Dewey defines this as "freedom from prejudice, partisanship, and such other habits as close the mind and make it unwilling to consider new problems and entertain new ideas." A second prerequisite is that of "whole-heartedness." This requires thorough immersion in the problem to be solved by reflective thought. Dewey makes this point because he feels that instruction is often superficial; teachers move students from one topic to another without the in-depth engagement Dewey feels is necessary to achieve effective thinking. (Theodore Sizer, in Horace's Compromise (9), makes a similar point when he argues that "less is more," and calls for fewer subjects to be studied with more intensity.) A third attitude Dewey labels responsibility. By this he means that reflective thought requires a person to understand all of the consequences of a solution to a problem.

In order to become an effective thinker, the natural curiosity of persons must be reinforced. Students must also be encouraged to generate spontaneous ideas. The generaton of ideas (which Dewey calls "suggestions") in an uncritical manner leads to a larger number of options for the solution of a problem.

Dewey indicates that orderliness is an additional prequisite for improved cognition. "Reflective thinking," he argues, "implies consecutiveness,

continuity...<and> ordering of suggestions <ideas>".

Dewey identifies five phases of reflective thought. The process begins when the person is genuinely perplexed, troubled or confused by a situation. It ends when the situation is resolved in a satisfactory manner. The five phases include the following:

> In between, as states of thinking, are (1) suggestions, in which the mind leaps forward to a possible solution; (2) an intellectualization of the difficulty or perplexity that has been felt (directly experienced) into a problem to be solved, a question for which the answer must be sought; (3) the use of one suggestion after another as a leading idea, or hypothesis, to initiate and guide observation and other operations in collection of factual material; (4) the mental elaboration of the idea or supposition as an idea or supposition (reasoning, in the sense in which reasoning is a part, not whole, of inference); and (5) testing the hypothesis by overt or imaginative action. (1, p.107)

Dewey makes the point that while these five phases comprise a complete act of thought, they are not fixed. A weakness in the development of strategies for the improvement of thinking skills has been the identification of steps which must be followed. Often these are approached in a lock-step manner that can be self-defeating. Dewey emphasizes that his phases can occur in more than one order, they can also overlap.

Dewey indicates that learning concepts is part of the process of learning to think. However, he argues that the process must mirror the natural way in which children learn concepts. Simply giving students the definitions of terms does not lead to the effective mastery of concepts. When students learn these constructs in ways that are not derived from reflective thinking, cognition does not improve. Dewey's perspective on concepts is remarkably contemporary. The

problem of the use of excessive verbiage in teaching continues to exist.

Conceptualization, Dewey argues, begins with experience. Persons learn concepts by experiencing them. These notions become better understood as they are used and at the same time they become more general. The process of conceptualization is a central part of any system of learning how to think. An important benefit of conceptualization is improved transfer. Dewey writes:

> ...No one understands a general principle fully--no matter how adequately he can demonstrate it, to say nothing of repeating it--till he can employ it in the mastery of new situations, which, if they <u>are</u> new, differ in manifestation from the cases used in reaching the generalization. Too often the student and teacher are contented with a series of somewhat perfunctory examples and illustrations, and the student is not forced to carry the principle that he has formulated over into further cases of his own experience. In so far, the principle is inert and dead; it does not move into new facts or ideas. (1, p. 187)

Dewey's <u>How We Think</u> defined the study of thinking. Most contemporary studies of metacognition are derivations of Dewey's work.

TYPES OF THINKING

At least four types of thinking skills can be identifed. Dewey's notion of reflective thinking--whch begins with perplexity, confusion or doubt and ends with a solved problem--represents one kind of thinking. A second type identified by Dewey is conceptualization. Persons move from experience through a process

that results in the creation of concepts and general principles. These two types are important kinds of thinking. They facilitate problem solving and the abilitiy to use solutions in new situations.

A third type of thinking comes from philosophy and has been labeled critical thinking. This process focuses on the evaluation of ideas. It enables persons to ask significant questions in order to analyze solutions to problems.

Learning to think critically results in the establishment of relevant criteria for judging the validity of arguments. It includes skills such as the ability to distinguish fact from opinion and the ability to identify the nature and forms of propaganda. Critical thinking also includes the ability to identify points of view as well as skill in understanding the assumptions of an argument. It also involves the ability to interpret data and make inferences.

Critical thinking helps persons to understand the nature and implications of evidence. Effective critical thinkers are those who resist making judgements about political candidates on the basis of "sound-bites." They are persons who can go beyond the superficial to seek depth of understanding.

Creative thinking, a fourth mode of thought, leads to the production of new ideas. A variety of theorists have created considerable literature to explain creativity.

J.P. Guilford--a pioneer psychologist in the study of creativity--described the difference between divergent and convergent thought. Guilford defines creativity as the application of divergent thinking (thought which leads to new perspectives) to problems so that a transformation occurs.

Writer Arthur Koestler coined the term "bisociation" to describe the creative process. Koestler argued that psychologists historically relied on the concept of association, a behavioral notion that implies that persons connect

one idea with another in an essentially conditioned manner. In contrast to associationism, Koestler describes bisociation--a process by which human beings bring ideas together from different planes of experience. A creative act occurs when two sets of experiences interact or are "bisociated."

Alex Osborne developed a technique called "brainstorming" as a method of generating spontaneous ideas. The fundamental premise of brainstorming is the need for the uncritical acceptance of ideas until they can be tested. The process requires persons to generate as many solutions to a problem as possible; these are accepted in non-judgemental ways.

William J.J. Gordon's development of the synectics process is an extension and refinement of brainstorming which has resulted in a highly effective technique for producing innovative ideas. Gordon distinguishes between making the strange familiar (which is what teachers usually do) and making the familiar strange (which leads to creative behavior). Guilford's earlier distinction between convergent and divergent thinking is mirrored in Gordon's formulation.

In 1987, Gordon published The New Art of the Possible (2), his latest refinement of the synectics technique. It identifies a procedure for generating new ideas which can help those interested in understanding metacognition and for those seeking to improve their creative thinking skills.

It should be kept in mind that these four types of thinking--reflective thought, conceptualizaton, critical thinking, and creativity--are all interrelated aspects of the process of cognition. Separating them for analysis helps to demonstrate the complexity of thinking; ultimately, however, they must be integrated in an effective thinking skills program.

In an attempt to synthesize approaches to thinking skills, Vincent Ryan

Ruggiero has created a process which he calls holistic. Described in his book, Teaching Thinking Across The Curriculum (8), Ruggiero offers a five-step process for improving thinking skills. His process includes the following:

1. Exploration

This is the ability to identify challenges which will lead to improved thinking. Ruggiero suggests that Osborne's strategy of brainstorming is a way to begin exploration. The identification of unmet needs in a situation is another way to begin the process.

2. Expression

This Ruggiero defines as the ability to describe a difficulty. It relates to Gordon's system of synectics which always begins with a careful definition of the problem.

3. Investigation

This critical step involves the acquisition of information necessary to address a problem or an issue. Ruggiero suggests several sources for the acquisition of data including information found within the problem solver, ideas available from people around him or her, and also perspectives obtained from authorities. Ultimately investigation makes the solution of the problem possible.

4. Idea Production

This requires the development of alternative solutions to a problem or issue. J.P. Guilford once indicated that creative problem solving requires fluency, the ability to generate many possible outcomes. This is similar to Ruggiero's concept of idea production.

5. Evaluation and Refinement

This final step in Ruggiero's system of holistic thinking requires skill in distinguishing between good and bad solutions to a problem as well as the ability to analyze issues in a way that identifies answers that seem most reasonable.

METACOGNITION AND RESEARCH ON THE BRAIN

Growing information about the nature of the brain can add to an understanding of metacognition. The human brain, a tremendously complex organ, weighs only three pounds and contains approximately one hundred billion nerve cells called neurons. It is the linking of neurons into program structures that allows thought to occur. Koestler's concept of planes of experience can be viewed as program structures--neurons combined in response to experience.

The brain has often been described by using the metaphor of a computer. However there are limits to this analogy. Neuropsychologist Richard M. Restak writes:

> In general, most computers are designed to deal with information serially, that is, one bit at a time. Brains, in contrast, operate via subsystems that function in tandem, what in computerese is called parallel processing. While reading this book you can drink your tea without spilling it, listen for the doorbell announcing the arrival of a friend who is expected any moment, monitor the weather report on the radio that is playing softly in the background. This is parallel processing, and our brains thrive on it....(6, p. 257).

The significance of the brain's ability to process data in this way has implications for the teaching of thinking. Traditionally thinking has been approached as if the brain functioned exclusively by formal logic manner--a process of thought invented in the west by the ancient Greeks. While the brain can function this way, it is not the most efficient, brain compatible way of thinking. The brain is an instrument that works most effectively when it travels along several paths simultaneously--Restak's notion of parallel processing.

Leslie Hart has studied brain research and applied it to an understanding of human learning and the nature of human thought. He calls his approach "proster theory" (the term comes from combining the two words 'program' and 'structure.') The brain has a huge number of prosters; each one contains programs--repositories of learning that has taken place. Hart's concept of proster is reminiscent of Piaget's notion of schemata. The difference between the two is that Piaget derived his ideas intuitively while Hart has relied on empirical evidence based on physiological studies of the brain.

Learning and thought are cumulative. In order to obtain a new proster, it must be added to an old one. It follows that some prosters exist in each infants' genes. Furthermore, persons cannot effectively learn or think unless their learning is connected to ideas already in place (previously existing prosters). Expecting students to learn something for which they have no background helps to account for much poor performance in the classroom. Dewey understood this without the information available from contemporary brain reserch. In <u>How We Think</u>, he wrote:

> ...All judgment, all reflective inference, presupposes some lack of understanding, a partial absence of meaning. We reflect in

> order that we may get hold of the full and adequate significance of what happens. Nevertheless, something must be already understood, the mind must be possession of some meaning that it has mastered, or else thinking is impossible....(1, p. 139)

Hart makes a distinction between thinking based on symbol selection and manipulation (SSM) and thinking based on perception, analysis and choice (PAC). Symbol selection and manipulation requires a kind of rote memorization and resembles the mindstuffing described by Ruggiero. For Hart, SSM thinking is limited because it is based on linear thought which is not compatible with the most effective use of the brain. PAC recognizes the simultaneous manner by which the brain processes information and is therefore more effective in the development of thinking. Hart writes:

> It can be flatly stated, however, that the human brain is not organized or designed for linear, one-path thought. Most electronic computers do work linearly, one step leading to the next (although most recent sophisticated types give hints of not remaining quite so limited.) But the brain operates by simultaneously going down many paths. We identify an object, for example, by gathering information--often in less than a second--on size, color, shape, surface texture, weight, smell, movement, any sound it may make, where it is found, what else is with it, any symbol with it (such as label or price sign), how others are responding to it, and so on. All of these investigations by the brain to answer the question, "What is this?" go forward along many different paths, and branching paths, among the brain's trillions of connections, at the same time. (3, p. 52)

PAC is a process that seems congruent with the other descriptions of thinking described in this paper. It is consistent with Dewey's complete act of thought. When one choooses and combines prosters to solve a problem, this is

similar to Koestler's bisociation and Gordon's synectics. Hart's interpretation of brain compatible thinking is consistent with procedures advocated by persons studying thinking from a variety of perspectives.

FACILITATING THINKING

The study of metacognition, beginning with John Dewey and continuing into the present, provides a number of useful perspectives on how to facilitate thinking.

"Learning," wrote Dewey, "is learning to think." Human survival over a long period of evolutionary time has depended on the brain's ability to learn. The human species cannot outrun or physically defeat most other animals in nature. Human existence has depended on the ability to think and to learn. Therefore those interested in improving cognition do not have to teach thinking, which is a natural phenomenon already existing in all persons. Rather, thinking needs to be facilitated and ways to achieve this are abundantly clear.

Effective thinking occurs in a context which enables the learner to relate current reflection to constructs which are already present in his or her mind. Learning and thinking are always cumulative. Therefore one cannot reflect effectively unless a current perplexity can be viewed in the light of a previously solved problem. In brain theory this means that new, reflective thinking must be built on previously existing prosters. From Dewey's point of view, new ideas develop in relation to an already existing meaningful context.

In order to facilitate thinking, students must be stimulated by difficulties

which are real to them. The facilitator must create a sense of perplexity, confusion or doubt in order for thinking to begin. To do this, meaningful problems must be created. In the 1960's, The University of Minnesota Project Social Studies Curriculum Center was able to facilitate thinking about presidential decision-making by asking pupils to study President Kennedy's decision to quarantine Cuba. High school students in that era identified strongly with Kennedy and, therefore, his problems in the missle crisis were meaningful to them. Reflective thought seldeom occurs unless problems are perceived as genuine.

Whenever possible, thinking should be facilitated by experience. Students must work with actual data in order to conceptualize. Students can gather first-hand information in many ways. The can use interview and survey techniques to obtain social data. They can engage in hands-on concrete experiments to gain scientific information.

Students can also learn to think with vicarious experiences, such as thought-provoking films. The human brain depends heavily on vision to obtain information. Films are an excellent device for obtaining vicarious experience. Reading material with a high interest level can also provide these kinds of opportunities. Whether vicarious or direct, experience is a significant component of thinking and it must be used to facilitate cognitive activity.

Opportunities for creative and critical thought must exist. A great number of techniques have been devised which can help students produce new ideas (brainstorming, synectics, etc.). These can facilitate creative thought. Critical thinking skills can evaluate these products. Critical thinking can also be applied to strategies for implementing innovation.

Teachers can use the contemporary environment to facilitate a variety

of cognitive skills. Political speeches, television commercials, and many aspects of popular culture can be used to improve thought. Teaching students to evaluate messages designed to manipulate them can serve to create perplexity, confusion and doubt.

Instructors can facilitate thinking by improving the quality of their questions. Appropriate questioning techniques can help students apply their natural curiosity to issues so that reflective thought can occur. Questions used by teachers should be ones that allow for differing opinions. The discussion of an issue with two different sides can help improve cognition.

To facilitate thinking, teachers must 1) understand the nature of reflective, critical and creative thought; 2) be aware of the way in which the human brain works with regard to cognition; and 3) seek to consciously implement activities which improve thinking.

To be a facilitator of thinking is difficult because the educational environment (and the social climate in general) often discourages thinking and replaces it with mindstuffing, rote activity. Overcoming this requires conscious and continuing effort on the part of teachers.

SOME SPECIFIC TECHNIQUES

Reading and writing should not be overlooked as important strategies for facilitating thinking. Lauren Resnick, in Education and Learning to Think (5), argues that effective reading requires a reflective interaction between the reader and the material being read. The thinking processes of the reader require

him or her to provide a context for understanding what is being read; this goes beyond the simple decoding of words. E.D. Hirsch, Jr. makes a similar point in Cultural Literacy. Guided reading can therefore provide opportunity for reflective thinking as well as the opportunity to obtain vicarious experience.

Writing is also a process that facilitates thinking. In the progression from pre-writing, to information-gathering to organizing, to composing, to revision, the writer uses many cognitive skills including reflective thinking, conceptualization, creativity and critical thought. Greater emphasis on writing across the curriculum can improve cognition.

In addition, several other kinds of activities can be identified for developing thinking skills. The following represent only a sample of the many types of strategies available for helping students be more effective reflective thinkers.

BRAINSTORMING

Alex Osborne's technique for problem solving is one that can be useful for facilitating thinking. Brainstorming requires a group to identify as many solutions to a problem as possible in the hope that some of the ideas might be productive. Many kinds of problems can be studied in a brainstorming session; they can be made subject-specific, relating to any course that exists in the curriculum. When done correctly, brainstorming can be an effective procedure for facilitating thinking.

As a variation, students can engage in nonverbal brainstorming. In this procedure, students use crayons or magic markers and sheets of paper to generate ideas using drawings rather than words. Research on the brain

indicates that, for human beings, vision is a primary way to obtain data about the universe. Thus nonverbal brainstorming is a highly brain compatible technique for improving thinking.

CONCEPTUALIZATION

Many activities can help teach concepts in all academic subjects. An example from the social studies involves the use of news magazines. Students are asked to select an article from a recent issue of Time, Newsweek, or U.S. News and World Report. Each student selects a different story and then writes five questions about his or her article. Following this, two pupils work together to produce five questions which can apply to either article. Next four pupils compose ten questions that can be asked about any of the four reports that they have read. Students are then told to transform their questions into declarative statements. The result will be a set of ten conceptual generalizations about current events. These now represent hypotheses which can be tested using reflective and critical thought.

PUZZLES

A large number of logic puzzles are available from many sources. Once students learn a procedure for solving logic puzzles, they are able to continually improve their ability to reason.

Research on the brain demonstrates that group-based learning activities are highly brain compatible. Human beings increase their ability to create prosters when they work together. Using groups to solve logic puzzles helps

persons learn effective procedures and adds to the feeling of confidence in approaching these intellectual problems. Increased confidence supports the brain's ability to learn.

Other kinds of puzzles exist in addition to logic puzzles. Another example involving groups is a procedure called The Analogy Game. This activity enables students to develop skill in the use of metaphor. It proceeds in the following manner: One member of the group thinks of a famous person--living or dead--but does not tell who s/he has selected. The players then try to discover who has been chosen by asking the selector to answer questions in the form of analogies. (e.g. "If the person you are thinking of were an automobile, what kind of automobile would s/he be?") The person supplying the answers begins by indicating the sex of the chosen figure and tells whether s/he is a living or dead person. Then s/he supplies answers using appropriate metaphors. These analogies should relate to the essential character of the person rather than to his or her physical attributes. The players are allowed a limited number of guesses (usually three or four). If no one discovers the identity, the person who was "it" wins. S/he continues in that role until replaced by a person who guesses correctly. The one who gets the correct answer then has the opportunity to stump the group.

SIMULATION/GAMES

The process of simulation/gaming is a well-established instructional strategy that can be used in all courses in the curriculum. It is an excellent technique for facilitating thinking; research indicates that it is a brain compatible technique.

Many simulation/games can be used to facilitate thinking. Beat Detroit is a board game in which players learn to deal with problems that come from automobile ownership. Because of its subject matter, the game easily attracts the interest of students who usually want to own automobiles. The game requires participants to examine all of the issues related to ownership (including warranties, insurance, repair costs, recalls, used vs. new cars, and status). This simulation/game is an example of one that can be used to facilitate thinking.

Many games have been developed for use with the computer. What Would You Do?, a game available from the Minnesota Education Computing Center, requires decision-making and the planning of strategy. Students must use computer generated data to surivive on a fur trapping expedition while at the same time obtaining enough furs to make a profit.

A resource available to persons who wish to use gaming in their attempt to facilitate thinking is Horn and Cleves's The Guide to Simulation and Gaming for Education and Training (4) which annotates and evaluates hundreds of games in all academic disciplines.

SYNECTICS

This procedure, developed by William J.J. Gordon, offers much opportunity for improving thinking skills. Gordon's most recent book, The New Art of the Possible, is his most up-to-date description of the synectics procedure. Gordon also developed many exercises for classroom instruction in most disciplines. Some of these can be found in a publication called Strange and Familiar, available from SES Associates in Cambridge, Massachusetts.

SUMMARY

Insight into metacognition can be derived from John Dewey's How We Think, first published in 1909. Dewey introduced the notion of reflective thought, which he distinguished from ongoing, random thought. He analyzed conceptualization as a significant component of cognition. Dewey also describes a series of phases which he calls a complete act of thought.

Creative thinking and critical thinking are two additional types of cognition. Creativity leads to the production of ideas while critical thinking aids in the evaluation of them. In general, critical thinking has been a product of philosophy while psychologists interested in innovative behavior have produced a considerable amount of literature about creativity. Vincent Ryan Ruggiero has sought to synthesize forms of cognition in a process called holistic thinking.

Additional understanding of thinking can be obtained from the study of the brain. From this research, neuropsychologists have learned that the brain works best when information is obtained through parallel processing rather than from serial types of formal logic. The brain uses neurons to create program structures. Learning is a cumulative process in which the creation of new ideas depends on their connection to old programs.

Thinking is facilitated when new ideas are related to already exisitng ones. Students must be stimulated by perplexing problems which have genuine meaning for them. Actual and vicarious experience enables students to improve their cognitive skills. Helping students to understand the nature of the

contemporary social environment can also facilitate thinking.

A number of specific techniques can be used to aid in the development of thinking. These include, but are not limited to, reading, writing, brainstorming, exercises for conceptualization, varieties of puzzles, simulation/games and activities designed to facilitate creative behavior.

BIBLIOGRAPHY

1. Dewey, John. How We Think. Boston: D.C. Heath and Company, 1933.

2. Gordon, William J.J. The New Art of the Possible. Cambridge, MA: Porpoise Books, 1987.

3. Hart, Leslie A. How The Brain Works. New York: Basic Books, 1975.

4. Horn, Robert and Anne Cleves, eds. The Guide To Simulation and Gaming for Education and Training. Beverly Hills, CA: Sage Publications, 1980.

5. Resnick, Lauren B. Education and Learning to Think. Washington, DC: National Academy Press, 1987.

6. Restak, Richard M. The Mind. New York: Bantam Books, 1988.

7. Ruggiero, Vincent Ryan. Saving Your Child's Mind. Springfield, Illinois: Charles C. Thomas, 1988.

8. Ruggiero, Vincent Ryan. Thinking Across the Curriculum. New York: Harper and Row, 1988.

9. Sizer, Theodore R. Horace's Compromise. Boston: Houghton Mifflin Company, 1984.